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COMMENT ON EQUAL VELOCITY ASSUMPTION FOR NEUTRINO OSCILLATIONS

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The so-called equal velocity prescription for neutrino oscillations is forbidden kinematically.

In a recent article[1] it was suggested that when considering neutrino oscillations one can assume that neutrino mass eigenstates have equal velocities.

Independently and later the equal velocity scenario was suggested in Ref.[2]. The authors of Ref.[2] consider this scenario as "aesthetically the most pleasing". They proclaimed it as their "preferred choice" in particular because it leads to the frequency of neutrino oscillations twice as large as the standard one.

Somewhat different approach is preferred by the authors of Ref.[3] who consider the equal velocity prescription on the same footing as the well known prescriptions of equal energy or equal momentum (see Refs.[4–7] and the literature therein). In particular, in Ref.[3] it is stated that none of the three prescriptions holds in pion decays or in any two-body decays.

The aim of this note is to stress that unlike the two "traditional" prescriptions, that of equal velocity is forbidden by simple kinematical considerations. This was shown in Ref.[7] which contains notes of a lecture given at the 1999 ITEP International Winter School. During that lecture Yu. Dokshitzer raised the issue of equal velocity case. The answer was that assuming $v_1 = v_2 = v$ one immediately arrives $\gamma_1 = \gamma_2 = \gamma = 1/\sqrt{1-v^2}$ and hence to $E_1/E_2 = m_1/m_2$. This equality cannot hold, because $E_1/E_2 \approx 1$, while m_1/m_2 may be extremely small, or extremely large. We want to emphasize here that this reasoning is equally valid for two-body as well as multi-body decays.

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